Vol. IX SEPTEMBER, 1898 No. 9

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

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WASHINGTON
PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

FOR SALE AT BRENTANO'S:
31 UNION SQUARE, NEW YORK; 1015 PENNSYLVANIA AVENUE, WASHINGTON;
218 WABASH AVENUE, CHICAGO; 37 AVENUE DE L'OPERA, PARIS

Price 25 Cents REPRINT $2.50 a Year

Entered at the Post-office in Washington, D. C., as Second-class Mail Matter.

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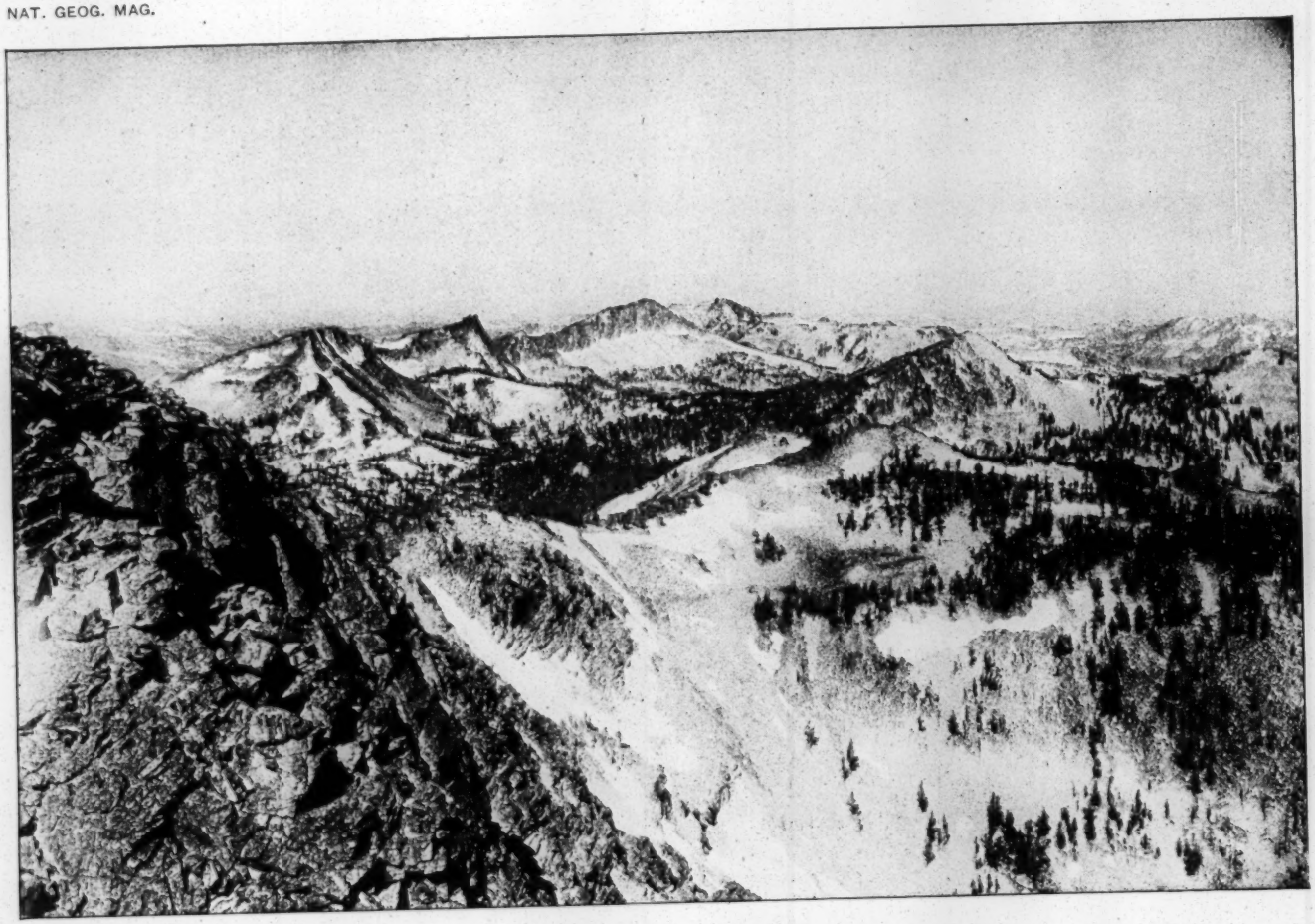


CREST OF BITTER ROOT MOUNTAINS

THE

National Geographic Magazine

VOL. IX SEPTEMBER, 1898 No. 9

THE GROWTH OF THE UNITED STATES*

By W J McGEE,

Vice-President of the National Geographic Society

With the annexation of Hawaii an end came to America's longest period of inactivity in territorial expansion. During this period of thirty-one years—nearly an average generation—the great fact of almost unparalleled expansion in earlier decades has been half forgotten.

Beginning with an area of 827,844 square miles and a marine coast line of full 1,500 miles, the nation concentrated energy on internal affairs for twenty-three years; then, in 1803, the Louisiana purchase was consummated and Oregon territory was acquired, adding 1,171,931 square miles to the national domain and 1,000 linear miles to the coast line; so that at a single bound the territory was more than doubled and the coast line nearly doubled, while an outlet was gained on the Pacific. The material expansion was quickly reflected in a widening of intellectual horizon among the people, who were thereby confronted by new problems; for, under republican organization, national problems are problems of the people rather than of leaders only. The immediate result was renewed intellectual and industrial activity and the implanting of a trait which has since become national, *i. e.*, enterprise; the more remote effects included development of interior commerce, the application of steam to inland navigation, the founding of a foreign carrying trade, and the real opening of that career of invention and manufacture which has given character to the American people.

*An address delivered at the Joint Session of the National Geographic Society and the American Association for the Advancement of Science, Boston, August 25, 1898.

After eighteen years of internal development, with a single international episode, Florida was acquired (in 1821), adding 59,268 square miles of territory and nearly 1,500 miles of coast line; and such further impetus was given to enterprise that the more southerly Americans soon found their territory too narrow and pushed beyond the border. A consequence of this overflow was the separation of Texas from Mexico, followed in 1845 by the annexation of this empire of 376,163 square miles, with 500 miles of coast line; another consequence was the treaty of Guadalupe Hidalgo in 1848, bringing in California and adjacent territory amounting to 545,753 square miles and adding another 1,000 miles to the coast; and a less direct consequence was the Gadsden purchase in 1853 of 44,641 square miles, rounding out the home territory to its present area of 3,025,600 square miles, with some 5,500 miles of open coast.

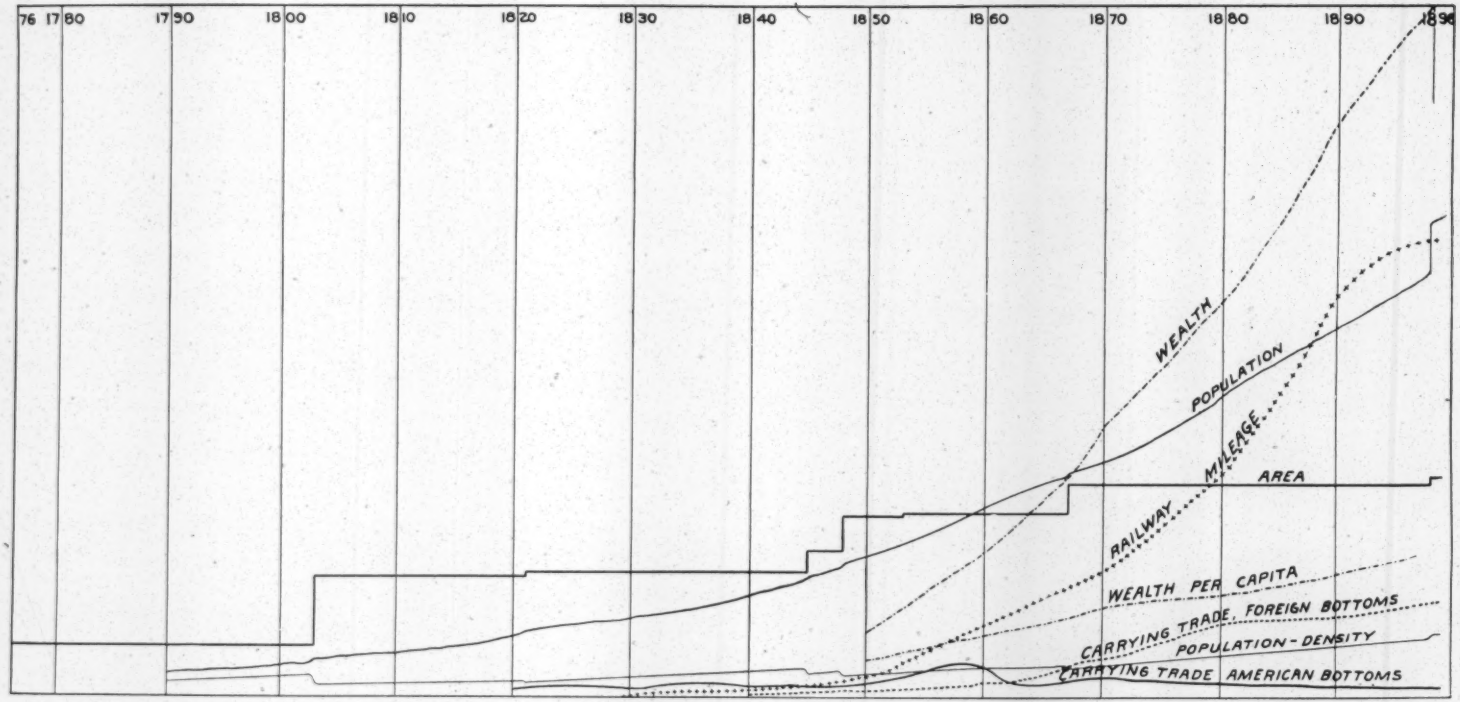
This career of territorial expansion in the half century from Louisiana purchase to Gadsden purchase forms the most striking chapter in national development afforded by the history of the world. In the first place, the actual expansion in territory and coast line was almost unparalleled; the area was nearly quadrupled and the coast line more than tripled. In the second place, the greater part of the acquisition was amicable, coming in part as a voluntary offering, while in no case did armed force play more than an incidental role; there was no conquest in the sense in which the term is used in other countries. In the third place, the expansion was beyond precedent in the completeness and promptness with which the new territory was utilized and the new conditions assimilated; with each areal addition national enterprise merely found a curb removed and sprang spontaneously to meet the new tasks and new problems presented by the new territory; and the energies of the people, withheld from martial conquest by moral sense, turned with unprecedented vigor to the conquest of nature, to the conversion of natural forces for human weal. Finally, the effect of the expansion on national character—foreshadowed by the advance of 1803—was beyond all parallel; for enterprise interacted with enterprise, and brought forth an individual and collective activity among the mass of citizens such as the world had not seen before.

After 1853 the nation rested from expansion for fourteen years, of which four were devoted to the solution of grave internal problems; then (in 1867) a bargain-counter acquisition, giving little

promise of early profit, was made, whereby a territory estimated at 531,000 square miles, with a relatively extensive coast line, was added to the national possessions. The influence of this purchase on national progress and on national character was limited, save as a hard-worked occasion for criticism of the policy of territorial development. The reaction from the internal tension of the early '60s and from the nearly profitless expansion of '67 naturally made itself felt in public policy; it is expressed in the thirty-one years of respite from external growth. Now, after long begging for admission, as Texas begged fifty years before, Hawaii is admitted, with 6,640 square miles of area and a wealth of coast line; the garden island of Porto Rico, 3,670 square miles in area, is gladly entering the domain of America as an incident of a war for humanity's sake; and the hundreds of Philippine islands, comprising 114,326 square miles of aggregate territory, are looking to America for protection and ultimate absorption. Considered merely as territory, these additions, aggregating 124,636 square miles, would form but a ripple on the stream of national progress, even if consummated at once; the area is little more than twice that of the Gadsden purchase, less than twice that of the Florida purchase, only a third that of the Texan annexation, less than a quarter so large as either the Californian acquisition or the Alaskan purchase, less than an eighth of the nation-shaping acquisitions of 1803, less than 4 per cent of the previous area.

Apart from the events of 1898, one of the striking features of American history has been almost unparalleled territorial expansion with quite unparalleled territorial assimilation; and, viewed in the light of this history, the comparatively slight expansion of 1898 but marks the resumption of a career temporarily checked by a combination of circumstances.

The territorial growth of the United States has been shaped constantly by natural conditions rather than national policy; for, since the days of the first President, it has been the idea of the American citizen to avoid "entangling alliances" and foreign complications. Partly for this reason, the rapid enlargement of the domain of the United States met opposition at every step from conservative statesmen. The Louisiana purchase was almost a surprise even to those by whom it was consummated, while a large part of Oregon territory was literally thrown away in 1846 by dint of political maneuvering, despite political platforms and the wishes of the inhabitants; and the self-pro-



Elements of growth.	1790.	1800.	1810.	1820.	1830.	1840.	1850.	1860.	1870.	1880.	1890.	1898a.	1898b.
Area in square miles...	827,844	827,844	1,999,775	1,999,775	2,059,043	2,059,043	2,980,959	3,025,600	3,556,600	3,556,600	3,556,600	3,556,600	3,681,236
Total population	3,929,214	5,308,483	7,239,881	9,633,822	12,866,020	17,069,453	23,191,876	31,443,321	38,558,371	50,155,783	62,622,250	71,000,000	79,000,000
Population-density.....	4.75	6.41	3.62	4.82	6.25	8.29	7.78	10.39	10.84	14.10	17.61	20.00	21.46
Wealth	.....	.....	.....	.....	.....	.....	$7,136,000,000	$16,160,000,000	$30,069,000,000	$43,642,000,000	$65,037,091,197	.....	.....
Wealth per capita	.....	.....	.....	.....	.....	.....	$308	$514	$780	$870	$1,036	.....	.....
Railway mileage	.....	.....	.....	.....	23	2,818	9,021	30,626	52,922	93,296	166,691	190,000	.....
Carrying trade, foreign bottoms.....	.....	.....	.....	$14,358,235	$14,447,970	$40,802,856	$90,764,954	$255,040,793	$638,927,488	$1,224,265,434	$1,371,116,744	$1,600,000,000	.....
Carrying trade, American bottoms.....	.....	.....	.....	$113,201,462	$129,918,458	$198,424,609	$239,272,084	$507,247,757	$352,969,401	$258,346,577	$202,451,086	$190,000,000	.....

posed annexation of Texas was successfully resisted for years. The acquisition of California was regarded as a special menace, for the reason that its fertile valleys and commodious harbors were distant three months' journey by land and six months' voyage by water, while the territory was inhabited partly by treacherous aliens but mainly by savage tribes; yet cautious statesmen, emboldened by the success of the Louisiana purchase, ventured on the step despite the fact that America was still an experiment in nation-making, with no standing among the powers, with a population of but 20,000,000, and with narrow commercial and industrial resources; and the step proved the most important in the career of the nation. In this as in other cases the territory was ripe for acquisition by an enlightened nation; the inhabitants were ill-governed and desirous of change; there was a need, more or less fully felt, for the extension of enlightenment in the dark places. In no case, save possibly that of Alaska, has expansion grown out of mercenary motives; yet in no case, save possibly Alaska again, has the acquisition of territory failed to benefit the inhabitants of the territory acquired, the nation which made the acquisition, and the world at large. America's progress in territorial development has never been the outcome of ulterior policy; it has always been an expression of manifest destiny.

The various elements of national growth are intimately related; some of them are shown graphically in the accompanying table and diagram.* The fundamental element is area, which is indicated in the line platted by ordinates and abscissas in such manner as to show quantitatively the territorial accessions and the intervening periods of inactivity, the line being projected on the assumption that the entire area of the Philippines as well as Hawaii and Porto Rico will be absorbed during the year. The next element is population, which is shown graphically from the Census figures of 1790 and later decades; it, too, is projected on the assumption that the 109,000 people of Hawaii, and also the 807,000 people of Porto Rico and the 7,000,000 people of the Philippines, will be added to our population during the year. A function of these elements combined is population-density (*i. e.*, the average population per square mile), which is platted

* The values are mainly taken from Gannett's "Statistical Atlas," recently published by the Census Office, partly from the "Statistical Abstract" for 1897, recently published by the Bureau of Statistics of the Treasury Department, partly from the "Statesman's Year Book" for 1898.

from the Census figures with the same assumptions concerning expansion during 1898. The three lines of the diagram express several salient facts in American history: The territorial acquisitions have been enormous, much more than quadrupling the original area; no accession (up to 1898) has materially affected the population curve, yet the population has steadily increased by a normal growth of beautiful symmetry; the density of population has also increased in a symmetric normal, interrupted by each of the greater accessions in area. The only noteworthy break in the population curve is that representing the teeming Filipinos, though even this does not materially affect the density curve.

The steady increase in density of population in the United States is a striking and promising feature of national development; it is an equally striking and still more hopeful fact that, so far as the Census values permit determination, each accession has stimulated the increase of population and has soon been followed by an increased population-density.

While each accession of area has tended to hasten the increase in population, other effects of even greater significance have followed, though figures for the expression of these effects are lacking for the earlier decades in the history of the United States. The immediate effect of the acquisition of Louisiana and Oregon was increase in navigation, both oceanic and interior, with a decided advance in domestic commerce; budding enterprise was directed to invention and steamboats were placed on the rivers, while improvements in agriculture were diligently sought. These advances were stimulated anew when Florida was acquired, and American carrying trade came to be a factor in the progress of the world. During the period of concentration following these acquisitions, canals were projected as auxiliaries to the natural waterways, while railroading was gradually introduced as a sort of auxiliary to river and canal. Then came the epoch-marking accessions of the mid-century, with the necessity for more expeditious transportation facilities than navigable waterways and ocean-going vessels could possibly afford; and native genius responded by improving locomotives and railway-building beyond the most sanguine dreams of progressive statesmen, and made America a railway nation; and the curve representing railway development is one of the striking features in the graphic history of the United States.* The carrying trade

*The decline in railway building after 1890, shown in the diagram, should not be misinterpreted: it merely marks the gradual substitution of electric locomotion, bicycles, etc., for steam locomotion.

in American bottoms also was stimulated, and its increase for a time almost kept pace with the growth of railroading; but the natural conditions which rendered the railway a necessity did not force genius and capital toward ship-building and maritime commerce, and, when internal conditions checked these activities in the early '60s, they were not resumed but permitted to fall into foreign hands. Accordingly there is a single element of American growth which is of negative character, a single direction in which the less brilliant genius of non-American promoters has been allowed to sap American strength, as shown by the curves representing the American carrying trade in American and foreign bottoms from 1820 to 1897.

The growth of the nation is indicated in an external or superficial way by the increase in area, population, and commercial agencies, and that growth has been unprecedented in uniformity and rapidity, as indicated by the lines in the diagram; yet the essential elements of American growth cannot be expressed in square miles of area, in linear miles of railway and waterway, in transportation tonnage, or in other definite units; the real growth lies in the development of enterprise, intellectual and moral and physical vigor, or, in brief, intelligent individuality. The strength of America is indeed faintly suggested by broad territorial expanse, teeming millions of people, and half the railways of the world; the real strength lies in the immeasurable capabilities of individuals, who have already made noble conquest of nature's forces; and there are no units for measuring the spontaneous powers of freemen united by common impulse in the common task of elevating mankind and bettering the world. While there is no direct way of measuring the individuality—much less the unity—of the American people, there are certain values indicating this quality even more clearly than area or population; one of these is wealth, individual and collective.* Unfortunately, early figures for the expression of wealth

* Mulhall's latest estimates of national wealth in the several countries are as follows:

United States	$81,750,000,000
Great Britain	59,030,000,000
France	47,950,000,000
Germany	40,260,000,000
Russia	32,125,000,000
Austria	22,560,000,000
Italy	15,800,000,000
Spain	11,300,000,000

These computations are based upon values as shown by real-estate records, buildings, merchandise, and railways, as well as the circulating medium in each nation.—*Financial Review, vol. vii, No. 9, 1898, p. 5.*

are lacking, but since 1850 wealth has increased more rapidly than any other measurable factor in national progress, as illustrated by the remaining curves in the diagram. In the last half-century the population of the United States has more than tripled, yet the wealth has more than thrice tripled, and the per capita wealth of the American citizen has risen far above the corresponding value for the other countries. This element of growth, too, is correlated with the increase in area, especially the epochal accession of half a century ago; for, although the statistics are wanting for the first half of the century, mere inspection of the later curves shows that the rate of increase must have been at least doubled or tripled almost immediately after the acquisition of Texas and California.

On reviewing the factors of national development, it becomes clear that territorial expansion, great as it has been, is not the principal one; for population has increased much more rapidly than area, while wealth (a partial expression of individual enterprise) has increased three times more rapidly than population—it becomes clear that American progress resides in the conquest of nature rather than in conquest of nations. Yet it is equally clear that every territorial accession gave new opportunity for growing enterprise, and was soon followed by new industries, new associations, new lines of thought, all contributing to increased individual wealth and augmented national strength. It is no less clear that the character of the territorial accession has shaped the character of the consequent progress: The Louisiana purchase created a demand for navigation of the Mississippi and its tributaries; the demand was met by the native genius which is always with us, and the finest steam-packet system in the world was developed to meet it. The conquest of California created a demand for transportation facilities; it was met by the development of the American railway system. The pushing of population into the arid districts created a demand for irrigation; it has been met by the development of irrigation engineering, irrigation laws, and other features of an irrigation system which marks an era in national history. On the whole it seems clear that the several factors of development are interrelated in a manner so natural and necessary as to produce that normal growth so conspicuous in the history of the United States; that the rapid territorial expansion of early decades was not too rapid for assimilation in the national structure, yet was rapid enough to meet national needs.

A glance from the history of the nation to the century's history of the world indicates the force and beneficence of the American example; the relations are too many for even summary statement; it may only be noted that the absorption of American ideas and the imitation of American methods by other peoples and nations proves that the progress of this nation is meeting a need of the world.

Cautious students presage the future from the history of the past; and the American of today must look to the lessons of 1803, 1821, 1845, and 1848 for indications of results to follow from expansion in 1898. The trend of these lessons is clear. After a generation of concentration, American energy is more tense than ever before; American enterprise and capital are overflowing in every direction—in Canadian mines, in Mexican railways, in South American plantations, and in scores of other ways; American progress has outstripped that of the rest of the world in every line save that of oceanic shipping; American genius will not be pent and is bound to diffuse itself by individual effort if not by national action. Such is the present condition of the United States, as demonstrated by any fair arrangement of figures or growth-curves—the young giant is rending his chains. The prospect is definite: Just as the Louisiana purchase in 1803 made America a steamboat nation, and just as the acquisition of California in 1848 made America a railway and telegraph nation, so the acquisition of Hawaii and Porto Rico and above all of the Philippines in 1898 must make America the naval nation of the earth; for the problem born of the accession would be that problem of navigation which needs American genius for its final solution, while America needs the incentive to strengthen that element in which alone she is weak. The Philippines are remote—only a fraction so remote in time as was California a half-century ago, yet remote enough to compel the invention of devices for shortening time and annihilating space; and the problem of bringing Manila within a fortnight of San Francisco is one worthy the genius of the inventors of the innumerable devices involved in steamboating, railroading, and telegraphing. Given swift vessels, the other problems presented by the Garden of the East are of little consequence save as forecasting directions for the profitable expenditure of long-pent energy; the 7,000,000 pastoral natives and tax-gathering Spaniards are a far less menace to our quadrupled population and multiplied power

than were the savage tribes and resident Mexicans of California; while it is the special function of the republican form of government to render the inhabitants of acquired territory not only self-supporting but self-governing. The progress of mankind may be measured by advance in speed of locomotion, beginning with fleetness of foot, coming up through fleetness of ridden and driven animals, and ending with swiftness of locomotive engines and sea-going craft; and, with vessels of sufficient swiftness and projectiles of sufficient velocity, there need be little fear of foreign complications, little occasion for maintaining great navies; for, if commercial competition be but aroused, individual effort may be trusted to develop the devices required for national protection. The fact that a quickly converted merchantman commanded by a Sigsbee, or that a hastily armed yacht commanded by a Wainwright can wreck torpedo-boat destroyers and naval theory together is full of promise, since it is the normal function of a free nation to produce Sigsbees and Wainwrights, to develop swiftness and certainty of action, and to meet emergencies as they arise. Nor need there be fear of occasion for large standing armies, since citizens require no such restraint and constraint as unwilling subjects, and are ever ready to rise in patriotic and thinking might to support the nation of which they are voluntary parts.

The history of the growth of the United States is one of unequaled progress in territorial acquisition, in normal development of population, in augmentation of wealth, and, above all, in development of a national character in which individual enterprise and capacity are the most conspicuous traits. There is but a single line in which progress has been sluggish, and that is the line which must inevitably be strengthened through the stirring episodes of 1898; and, in case the accession extend to far Luzon and Mindanao, America must soon lead the world in ocean navigation as in other directions, and begin a conquest of the sea no less complete and noble than the conquest of the land already wrought. More than all else, the territorial acquisitions must contribute toward the extension of enlightenment, toward the elevation of humanity, and toward the ultimate peace and welfare of the world.

He errs who forgets the history of his country. Every citizen of the United States would do well to remember the decades past, and realize that the growth of 1898 marks no new policy, and is but the normal continuation of a course of development successfully pursued for a century.

BITTER ROOT FOREST RESERVE

By Richard U. Goode,

U. S. Geological Survey

As a result of inadequately framed laws, of the indifference of those charged with the execution of these laws, and of the reckless greed of private enterprise, the forests of this country, which at one time were of vast and apparently inexhaustible proportions, are gradually wasting away. In 1860 there were about 20,000 saw-mills, in 1870 about 26,000, and in 1880 about the same number; in 1890, however, the number was reduced to about 21,000, this reduction being largely due to the fact that the supply of available material was becoming scarcer and more inaccessible.

Practically, it has been impossible to place any restraint upon those desiring to use the timber on the public lands for any purpose whatever. One law provides that citizens may cut and remove for building, agricultural, mining, and other domestic purposes any trees growing on mineral lands, while another permits residents to take timber from non-mineral lands—and the land is usually held to be mineral or non-mineral as may suit the particular case. There are numerous other laws on the statute books under which timber may be taken under some show of legality, and in taking out the matured trees no attention has usually been given to the preservation of the young growth, and much that could not be used has been destroyed. Added to the above causes have been the forest fires, started either through accident or design, so that the question has begun to assume such a serious aspect that prompt measures have been deemed necessary by those interested in the preservation of the forests.

As a result of this agitation, a commission of the National Academy of Sciences was appointed in 1896 for the purpose of making an investigation of the subject. This commission submitted a report recommending the establishment of thirteen forest reservations, containing an aggregate area of 21,379,840 acres, or about 33,400 square miles. In conformity with this recommendation President Cleveland, under date of February

22, 1897, set apart from entry or settlement the various areas as recommended, one being the Bitter Root Forest Reserve. Previous to this there had already been established by Executive proclamation, in various localities in the West, reservations comprising a total area of 17,500,000 acres, or about 27,300 square miles.

Following immediately upon President Cleveland's proclamation protests and complaints began to pour into the Executive Mansion, and when President McKinley came into office he found himself in a somewhat embarrassing position, people having interests that were supposed to be detrimentally affected claiming that the reservations had been made without thorough investigation and without consulting local requirements. In order to relieve the situation and to obtain time for further investigation, legislation was enacted providing for the survey by the U. S. Geological Survey of all lands heretofore designated as forest reserves, suspending President Cleveland's proclamation, except as to the reservations in California, and restoring all others to the public domain, but providing that such lands not otherwise disposed of before March 1, 1898, should again become subject to President Cleveland's proclamation.

The function of the Geological Survey in the matter has been to ascertain and report on the facts relating to the forest reserves, so that intelligent action may be taken at the proper time as to the disposition of the whole question.

There is probably no portion of the country, exclusive of Alaska, about which there was so little known as of the territory included in the Bitter Root Reserve. It therefore became necessary to commence *ab initio*, as nothing whatever was available from a geographic standpoint. In considering questions of this kind the value of reliable maps cannot be overestimated. The engineer, the geologist, the botanist, or any one practically interested in any of the sciences, pure or applied, must have an accurate map as a basis for any thoroughly satisfactory investigation, and it thus came about that a large proportion of the amount appropriated for the forestry surveys was expended in the preparation of topographic maps.

The first step was to determine an astronomic position, measure a base line, and expand a system of triangulation which would serve to furnish starting and control points. A location for the astronomic station was selected in the town of Hamilton, Montana, and the latitude and longitude of a masonry pier built at

this point was determined. This work was performed by Mr S. S. Gannett, who had the coöperation in the longitude work of Professor H. S. Pritchett, then of the Washington University at St Louis, and now Superintendent of the U. S. Coast and Geodetic Survey. The latitude was obtained by circumzenith observations on 56 pairs of stars, and the longitude by time observations and telegraphic exchange of clock signals with St Louis on five nights. The probable error of the results obtained for this position was very small, so that it was certain within a few feet, the surface of the whole terrestrial globe being taken into consideration. The next process was to measure a base line one end of which would be connected with the astronomic pier. This line was measured along a tangent of the Northern Pacific Railroad. The total length of it was 5.33 miles, and the difference between the two measurements after all corrections had been applied was about 1 inch—that is, the probable error was about 1 : 338000 part of the length.

From this base line was expanded a system of triangulation, which was executed with great care within certain limits, the triangles closing with an average error of 2 seconds. Beyond these it was extended as a reconnaissance survey, but it is believed that the results obtained will be entirely sufficient for map-making purposes, although it will eventually be completed in a more refined way. The surveys were under the general direction of Mr E. C. Barnard, who was personally in charge of a party engaged in the detailed mapping of the Bitter Root valley and the adjacent mountains. He had as assistants in charge of sub-parties Messrs J. B. Lippincott and H. S. Hackbusch.

The bounding lines of this Reserve are defined in part by the land lines of the public land system, none of which had been surveyed. For the purpose of locating these boundaries and also for establishing a basis from which other township and section lines could be projected a special party, under Mr Hackbusch, was organized, and the results of this work were the determination and marking of the greater portion of the eastern boundary. The existing law relating to the subdivision of the public land requires that all linear measurements shall be made with a chain, a method which in a heavily timbered and mountainous country is very inaccurate and laborious. The men engaged in this class of work encountered many hardships, exhausted their physical strength, and were able to accomplish so little at a large expense that the question of the feasibility of

doing it by triangulation presented itself, and legislation has been proposed granting authority to the Geological Survey to locate township corners in the forest reserves by this method.

The area of the Bitter Root Forest Reserve is about 6,500 square miles, about one-sixth being in Montana and the remaining portion in Idaho, the crest of the Bitter Root mountains forming the boundary line between the two States in this locality, and the problem presented itself as to how a satisfactory map, for the purpose of illustrating the forestry features, could be prepared in the comparatively short field season that the weather

YELLOW PINE GROVE

conditions made possible. A reconnaissance map was decided upon, and the assistant, Mr J. B. Lippincott, who executed the triangulation, was instructed to take with him a light plane-table outfit for the purpose of making such a map. The map prepared does not lay claim to absolute accuracy, but it is considered sufficiently so to answer the purpose for which it was made—that is, to show the drainage system, the general character of the forests, etc. Contours were sketched to show the relative differences of elevation and slopes, and such elevations as were mathematically determined are given in figures. Also on the maps are indicated all the trails and such wagon roads as exist. Mr Lippincott was also instructed to secure numerous photographs and to obtain all possible information relating to the forestry, the

agricultural and mineral development, and the hydrography of the Reserve, and many of the facts mentioned here are taken from his report.

No exact definition of what might be properly included in the Bitter Root mountain range has ever been authoritatively determined, and it is very doubtful if sufficient information as to the physiography of the region exists to satisfactorily settle the question present; but there can be no doubt that all of the Reserve under consideration is within the limits of the Bitter Root mountains. The conclusions of the writer in the matter are therefore to be taken as a broad generalization, to be modified as new facts are brought to light.

First, with reference to the crest line. This may be considered as extending on the north from the vicinity of Lake Pend d'Oreille to the low divide at the south end of the Bitter Root valley between the drainage of the Bitter Root creek and that of the north fork of the Salmon river. It is thought that these mountains should not include territory further southward, as it is considered desirable to classify the Bitter Root range as entirely tributary to Pacific drainage. The continuation of the divide southward is drained to the eastward by the tributaries of the Missouri and should properly be included in the Rocky Mountain system. The northern portion of the Bitter Roots, as thus defined, will include the Cœur d'Alène mountains, as it is believed that the latter should not have a coördinate rank in the orography of this region, but should be assigned as a subordinate range of the Bitter Root system. If an attempt is made to differentiate these two ranges as independent systems, St Regis pass would serve to break the continuity. With the assumption of continuity, the eastern and northeastern limits of this system become very easily defined—that is, by the drainage of the Clarke's Fork of the Columbia. It seems also very clear that the Salmon river should define the southern limits of these mountains. Just how far to the westward they should be considered as extending is not clear, but, as a preliminary classification, they may be determined as extending toward the Snake river plains until they lose their identity as mountain masses. This classification would assign the Clearwater mountains to a secondary position in the same manner as the Cœur d'Aléne have been subordinated.

In detail, the principal drainage systems in and adjacent to these mountains are the Bitter Root, the Clearwater, and the

Salmon rivers. On the eastern slope is the Bitter Root river, one fork of which heads in the southeast corner of the Reserve and flows northward through the fertile valley of the same name. This valley separates the Rocky mountains from the Bitter Root range for a distance of about 100 miles and at present has a good agricultural development. The main valley has a width of about 8 or 10 miles, its floor being comparatively level, composed of lacustrine deposits and very fertile under irrigation. When the drainage of the ancient lake occurred there was left a heavy deposit of gravel and other sediment, through which the Bitter Root river is still cutting, and this process has shifted the floodplain back and forth, the result being that in some portions of the valley well defined terraces have been carved out corresponding to the older floodplains.

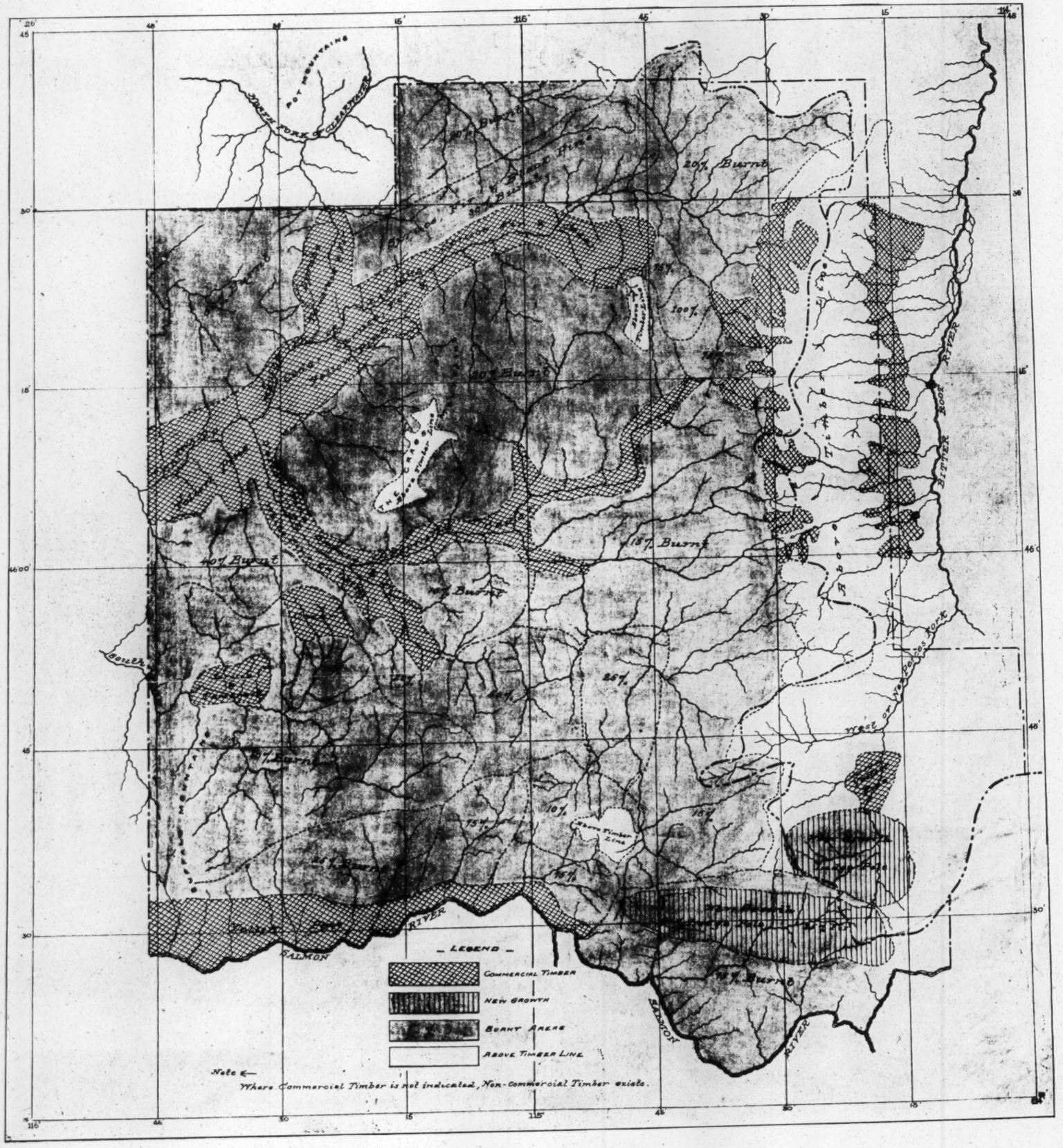
The Bitter Root river joins the Missoula near the town of the same name and ultimately finds an outlet in the Columbia river through Clarke's Fork and Lake Pend d'Oreille. The streams constituting this drainage are remarkably straight and of a very steep gradient. Their tangent-like course is due primarily to glacial agencies, and they have not become modified on account of the extreme hardness of the rocks. They seek the straight and direct course and do not loiter amid the inhospitable granite to carve out for themselves gentle curves. In their haste to reach the valley they leap and jump and are tossed from boulder to boulder, now lashing themselves into fleecy whiteness and now circling in emerald eddies as they plunge into some quiet pool, where they find a moment's rest and gather strength for their ever-downward course. The beds are filled with boulders, and the sides of the canyons are precipitous and almost entirely bare of vegetation. These streams in their incessant activity are not only continually deepening their own beds in the attempt to reach baselevel, but are gradually working their way westward and capturing the tributaries of the less active affluents of the Clearwater, causing what is termed a migration of the divide. The shifting or migration of a divide is due to the weathering or wasting away of the crest line, and may result from various causes. It seems probable that the main crest of the Bitter Roots has moved to the westward, owing to the fact that the highest points at present are all east of the crest line. Ward peak is 8 miles to the east and about 800 feet higher than the general elevation of the divide, and St Mary's and El Capitan peaks each attain an elevation considerably higher than the divide.

CEDAR FOREST ON MOOSE CREEK

The portion of the Reserve west of the summit of the Bitter Root mountains (that portion in Idaho) is drained by the Clearwater and Salmon rivers, about 90 per cent of the territory being tributary to the former. Both of these streams are affluents of the Snake river, the Clearwater forming its junction at Lewiston and the Salmon about 50 miles above, to the southward. The Salmon has no important tributaries within the limits of the Reserve. The Clearwater has four principal branches—the North Clearwater, the drainage area of which is largely north of the Reserve; the Laksha, or Middle Clearwater, which has its source about the base of St Mary's and St Joseph's peaks; the Main Clearwater, which drains the crest line from Lost Horse pass to the Nez Perces pass, and the South Clearwater, or American river, the smallest of the four, whose drainage basin is in the southwestern portion of the Reserve and extends within a few miles of the canyon of the Salmon river. It may be mentioned that the location of the Salmon river in this locality, as shown on the best existing maps, was found to be in error by from 10 to 15 miles.

The streams constituting the Clearwater system flow generally in a western direction, and while the various affluents come from almost every direction, the general result is a series of secondary east and west ranges which have no well defined connection with the main range. The summits of the ridges are from 3,000 to 5,000 feet above their enclosing canyons, and each ridge rises to the same general elevation, so that were a surface laid through all the crest lines it would be of an undulating and moderately irregular character. We may therefore assume with some degree of certainty that the surface represents an old topographic form—an old plain or peneplain of denudation to which the country was reduced after a long period of erosion.

The rocks of the Bitter Root mountains are granites and slates, the granite formation being the northward continuation of the enormous granite mass of southern Idaho, one of the largest in the United States. The slates, which are confined to the northern portion of the Reserve, constitute a part of the Belt formation, these rocks being the oldest stratified beds of the Rocky Mountain region. At some period since the Carboniferous the great body of granite out of which this immense tract was carved was injected as a molten fluid mass from below upward into the slates. This molten rock cooled slowly, as is shown by its coarseness of grain, and it must have cooled beneath a cover of slates; but this cover has been almost entirely removed and the



MAP OF THE BITTER ROOT FOREST RESERVE

granite itself deeply cut and dissected. At the time when volcanic activity was so predominant a feature in the Yellowstone Park and the great lava flows of basalt dammed up the Snake and Columbia rivers west of these mountains, the Bitter Root valley was effected by tilting of the earth, so that the drainage was in many cases reversed and the Bitter Root river was dammed back, forming the Bitter Root lake, which was over 1,000 feet in depth.

The overflowing waters of the lake gradually deepened the outlet and drained the lake, clearing out a large part of the sediment, a work not yet entirely accomplished, as the valley has not been cut down to its former level. The many lakes which nestle in the mountain amphitheaters and dot the plateaus are the result of glacial occupancy.

In connection with the reconnaissance survey a forest map was prepared, and it is published herewith. This map indicates the features of the forest in the broadest way, no attempt having been made to differentiate the species. Two zones of forest trees are native to the Montana slopes of the Bitter Root Reserve, the yellow pine and the subalpine fir, about one-fourth of the growth belonging to the former, which has a range from the lowest elevations to 5,800 feet, and three-fourths to the latter, which has a range from 4,200 feet to the highest altitudes. In the yellow-pine zone the yellow pine constitutes about 20 per cent of the growth and the hemlock spruce about 60 per cent, the remaining 20 per cent being distributed among the other trees included in the zone, the lodge-pole pine, white fir, and balsam fir. In the subalpine zone the lodge-pole pine constitutes by far the greatest portion (about 90 per cent) of the growth, the remaining 10 per cent being Lyall tamarack, subalpine fir, white-bark pine, white fir, Engelmann fir, and yew. Strictly speaking, only the yellow pine should be classed as commercial timber, as it alone is used for lumbering purposes; but on the map are included under this head the tamarack, the fir, and the white-bark pine, as they may be applied to local purposes and have to that extent some commercial value. The yellow pine may be considered as constituting the entire growth, as shown on the map, between the Bitter Root valley and the summit.

The areas indicated as bare on the map are not wholly so, there being no portion of the Bitter Root Reserve entirely above timber line, as everywhere, even on the loftiest summits and

most precipitous ridges, especially on the southern slopes, are found straggling trees, but for the purpose of graphic illustration it has been represented as it has.

Along the crest the growth is very sparse, but as the projecting spurs reach out to the westward and attain lower altitudes they are usually covered with a forest growth, except where their sides are too precipitous to admit of vegetation. There are on the western slopes of the Bitter Root mountains three primary forest zones, namely, the subalpine fir, the white pine, and the yellow pine. The subalpine-fir zone extends from the crest altitudes to about 5,800 feet above sea-level and includes the white-bark pine, the lodge-pole pine, the Engelmann spruce, the Lyall larch, and the subalpine fir. The white-pine zone has an approximate range from an altitude of 5,800 feet to about 2,000 feet, and includes the white fir, the lodge-pole pine, the Engelmann spruce, the cedar, and the yew. The yellow-pine zone extends from elevations of 2,500 feet in the valleys to nearly 6,000 feet on the western and southern slopes, and to 4,500 on the northern and eastern slopes, and includes the yellow pine, the white fir, the hemlock spruce, the lodge-pole pine, the western birch, the paper birch, the balm of Gilead poplar, and the aspen, besides various willows and alders. The distribution of the growth in the subalpine zone is about the same as in the similar zone east of the crest. The trees constituting the white-pine zone are divided approximately into three equal portions, the white fir forming one portion, the cedar the second, and the lodge-pole pine and Engelmann spruce the third. The species of trees occurring in the yellow-pine zone may be divided approximately into two portions, the hemlock spruce constituting one and the yellow pine and white fir the other, the former, however, being about three times more abundant than the latter. From the foregoing it will be observed that at least 98 per cent of the trees in the Reserve are coniferous, the exceptions being a few cottonwoods, maples, and various bushes bearing berries.

The most striking feature presented by this map is the large portion of it that has been burned over, nearly all of it having been visited at different times by fires and at least one-third of the standing timber having been destroyed. The map indicates clearly the burned zones, and an attempt has been made to show by the percentage figures the proportion of the timber that has been completely destroyed.

BURNT FOREST

The foregoing illustration depicts a scene of which all Americans should be ashamed. The aborigines held this region for many ages as a sacred trust transmitted from generation to generation. They recognized its beauty and utility and did naught to impair the grandeur of the one or the permanence of the other. And what has the Anglo-Saxon done? As a community is visited by a devastating scourge, as a face is disfigured by some foul disease, so have the forests been visited and disfigured by him. Reaping where he has not sown and failing to restore where he has destroyed, a noble heritage is slipping away through carelessness and cupidity. A hunter or traveler leaves his campfire unextinguished, a herder starts a fire in the fall that the coarse grass may be burned and in the spring be replaced by a tender growth which is more nutritious to his flock, the prospector burns the undergrowth that the mineral-bearing rocks may be uncovered, the result being that thousands of acres are devastated.

Illustrations are presented showing groves of yellow pines, cedars, and firs that have been undisturbed by fire, an area that has been burned over, and a view of the crest of the Bitter Root mountains.

The question may suggest itself as to why the area included in the Bitter Root Reserve should be set aside from entry or settlement. Three distinct reasons exist from a forest standpoint, and there are other interests that would be incidentally subserved.

First. The numerous streams which have their sources in the Reserve furnish the water supply for the irrigation of the Bitter Root valley on the east, and could be turned to a profitable account for a similar purpose to the westward. Indeed, it has been forcibly suggested that the possibility of irrigating the extensive plains of southeastern Washington exists only in the utilization of the Clearwater river for this purpose. There is at present considerable hydraulic mining in the Idaho portion of the Reserve, and this industry is limited only by the amount of available water supply, which, according to the testimony of the miners, has been materially decreased since the forest fires have become so extensive. It is safe to say that fully 98 per cent of the Reserve is unfit for agricultural purposes on account of the altitude and irregularity of the surface. The only possibilities in this respect, or even for grazing, are in the numerous alpine meadows; but it would be a dangerous experiment either to disturb the surface of these meadows with a plow or to allow cattle to occupy them extensively, as in either case they would lose

SUBALPINE FIR THICKET AND MEADOW ON MUSSEL SHELL CREEK

their peculiar sponge-like character, which makes possible the retention of the water deposit. Thus it seems clear that the reservation, if it were administered in such a manner as to prevent or at least check forest fires and keep out herds of cattle and sheep, would have a beneficial effect on the regimen of the streams.

Second. An important purpose to be subserved would be the prevention of the injudicious cutting of trees over large areas. It is not proposed to prohibit cutting to a sufficient extent to meet necessary demands, but to have it done under proper supervision, so that the young and immature growth may be protected and the production utilized in an economical manner. In other words, it is desired to provide for the handling of the tree crop with the same prudence and foresight as any other crop would be looked after.

Third. Large areas have been burned over, and it is a debt due to posterity that the damage be repaired. This end can be accomplished only by a systematic effort under proper direction. The Yellowstone National Park and the Yosemite Park have for several years past been patrolled by troops of cavalry of the U. S. Army, who have not only been able to keep watch on the class of people to whom these fires are usually traceable, but, by going promptly to localities where smoke is visible, have been able to extinguish with little exertion fires which, if

left alone, would in a short while have devastated large areas. In some European countries it has been found necessary in order to produce certain results in reforestation to transport soil in baskets by the hands of men to form a new covering for the naked rock, so that vegetation may be reëstablished. It is not probable that we shall ever be reduced to such extremities in this country, but we should resist all influences that have a tendency to produce such a condition.

Incidentally the game will be protected and the scenery preserved or restored to its original beauty. This section is the natural home of the moose, elk, bear, deer, mountain goat, and mountain sheep, but during the past season scarcely any of the above were encountered and very little sign of their presence was observed. The deer are killed in large numbers by commercial hunters to bait bear traps. In one locality 120 bears were trapped in two seasons, and it is considered a conservative estimate that for each bear secured 1,000 pounds of game meat is ordinarily used. The elk and the moose are nearly exterminated, and the region which once attracted sportsmen from all portions of the country, and also from Europe, has almost completely lost its attraction as a hunting ground.

[The foregoing article was presented at the Joint Session of the National Geographic Society and the A. A. A. S., Boston, August 25, 1898.]

ATLANTIC ESTUARINE TIDES*

By Mark S. W. Jefferson

The tidal phenomena of a number of commercially important estuaries on the Atlantic coast suggest a simple geographic classification.

There are two distinct tidal types, with corresponding types of geography. Both are united in the Delaware. Ascending the bay from the capes, a four-foot tide increases to six feet and falls off in speed from 23 miles to 11 miles per hour. Ascending the river, the range again diminishes from six feet to four feet, with a speed varying irregularly between 7 and 15 miles. The geographic types here are the bay, from the capes to Delaware City, and the river above. The combined type corresponds to the

* Extract from Thesis in research course in Geography at Harvard University, under Prof. W. M. Davis. Read at the Joint Session of the National Geographic Society and the A. A. A. S., Boston, August 25, 1898.

rias of northwestern Spain, tidal rivers emptying into tidal bays, both resulting from the drowning of older river valleys in the sea. The simple type is a valley cut in rocks of uniform texture, and flares uniformly toward the sea.

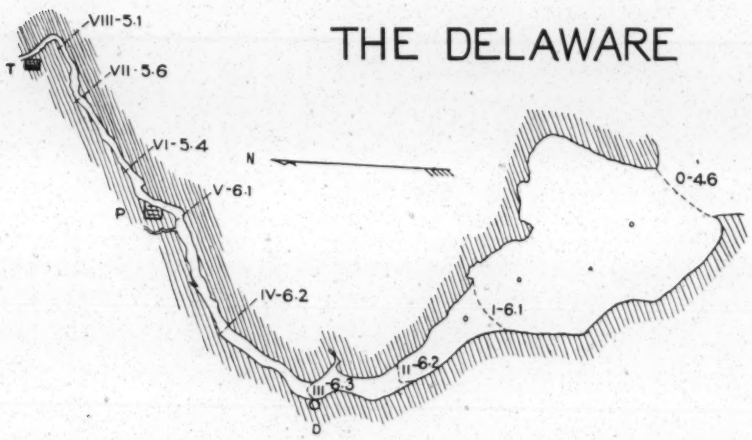
While the Delaware furnishes a good illustration of the combined type, the Chesapeake affords an exception of almost equal interest.

The following table summarizes the facts for the Delaware:

DELAWARE TIDES

0	I	II	III	IV	V	VI	VII	VIII	IX	H. W. interval from capes.
0	23	16	11	14	15	11	10	7	13	H. W. advance in last hour (miles).
4.6	6.0	6.2	6.3	6.2	6.1	5.4	5.6	5.1	4.1	Mean tide range (feet).
h. m.	*h. m.*	*h. m.*	*h. m*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	
6 25	5 43	5 37	5 25	5 25	5 19	5 7	4 49	4 43	3 55	Duration of rise.
6 0	6 42	6 48	7 0	7 0	7 6	7 18	7 36	7 42	8 30	Duration of fall.

The dotted lines on the map represent the positions of the progressing wave-front at successive even hours after it passes the capes. They are numbered with Roman numerals to the right,



the feet of range being also given in Arabic numerals. T = Trenton, P = Philadelphia, and the dots in the lower bay represent observation stations on shoals that enable us to ascertain the convexity of the advancing wave-front. From the table, and still more from the map, it appears that for the first three hours the tide advances with decreasing speed—23 miles the first hour,

16 miles the second, and 11 miles the third. During the same period the mean tidal range is increasing from 4.6 feet to 6.3 feet. These two characters are taken to define the bay type of tides:

(1) Progressive loss of speed
(2) Increase of tidal range
} up the bay.

Above Delaware City there is observed a steady falling off in the range. The rate of progress is here somewhat irregular. These two characters define the river type of tide:

(1) Irregular advance, commonly 10 or 12 miles per hour.
(2) Decrease of tidal range.

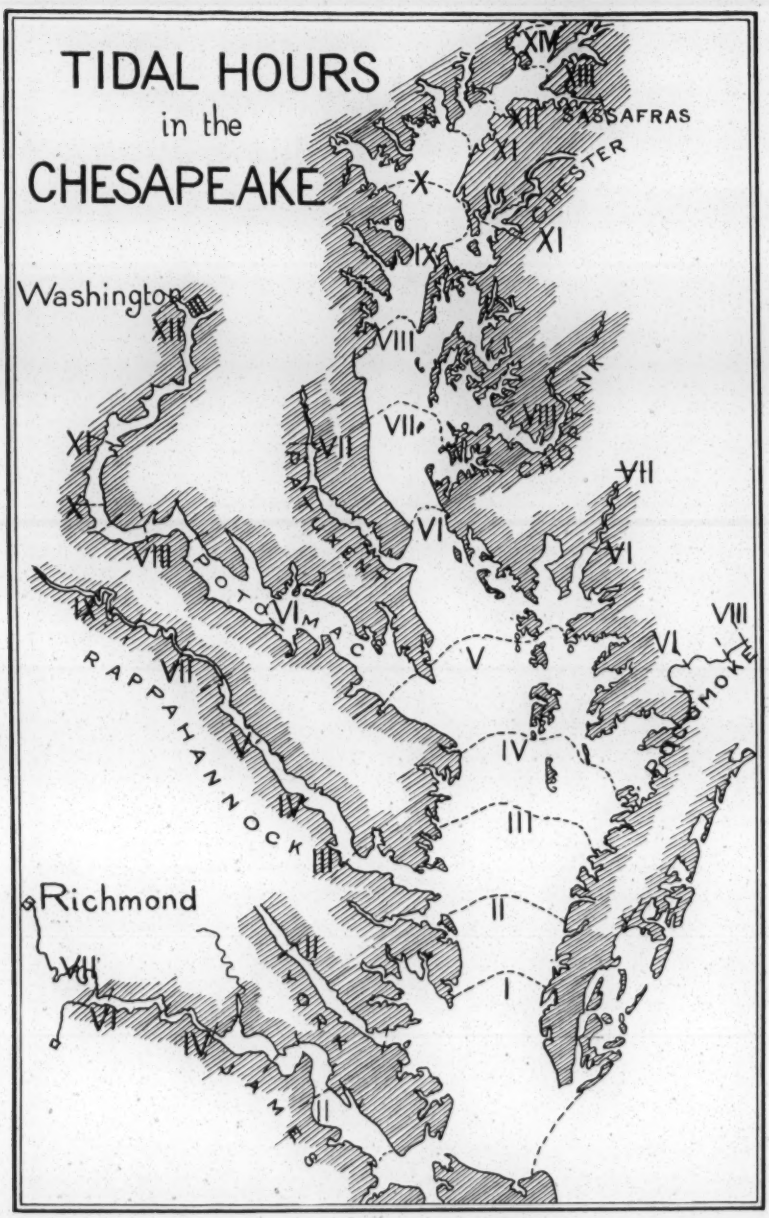
The last two lines in the table indicate a feature common to both types—the steepening of the front of the advancing wave, manifested in the times by quicker rise and slower fall. Outside of the estuaries, all along our Atlantic coast the times of rise and fall are equal. While bay and river together go to make up the geographic estuary, it may happen that one of the parts is missing, as with the Kennebec, which enters the sea by a narrow fiord and has no bay, or the Penobscot, shown by its tides to be wholly of the bay type. The Connecticut river has a sort of bay, but so choked with sediments as to be tidally inefficient. The Hudson enters the side of Raritan bay, both being good types of their kind, but not parts of one geographic whole. Chesapeake waters are anomalous.

The following are the ranges of the best illustrations in the area:

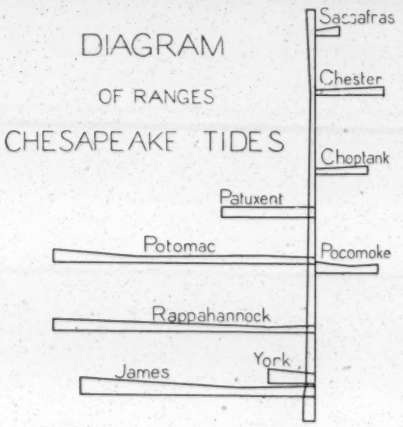
	Bay.	River.
St Lawrence	11′ to 14′	14′ to 0.9′
St John	.....	26″ to 6″
Penobscot	9′ to 13′	.....
Kennebec	.....	8.3′ to 4.3′
Connecticut	.....	3.6′ to 0.8′
Hudson	.....	4.6′ to 2.3′
Raritan	4.6′ to 5.4′	.....
Delaware	4.6′ to 6.3′	6.3′ to 4.1′

CHESAPEAKE TIDES

The Chesapeake is a drowned river valley into which drowned branch valleys pour abundant waters. Deep water is found within, yet the communication with the ocean is narrow and shal-


TIDAL HOURS
in the
CHESAPEAKE
SASSAFRAS
CHESTER
Washington
CHOPTANK
POTOMAC
RAPPAHANNOCK
PATUXENT
PATAPSCO
PATAPSCO
PATAPSCO
Richmond
JAMES
JAMES
JAMES

low. This constriction toward its mouth is shared by a number of the tributaries. The result is, in the main bay, a tide rather of the river or sound type. For two-thirds its length the range uniformly diminishes from 2.6 feet at the capes to 0.8 feet near Annapolis, a distance of 120 miles. So in the lower courses of the greater tributaries, the James, the Rappahannock, and the Potomac, ranges decrease or waver, as may be noted in the accompanying diagram. The rate of high-water advance is also irregular, as appears on the map; but the upper course of the bay and larger rivers and the whole course of the smaller streams have bay tides as far as ranges are concerned—*i. e.*, the tide range increases upstream. Though this is not accompanied by the progressive retardation of the true bay tide, it makes the Chesapeake waters present a curious inversion. Ranges of the river type are interposed between bay tides and the ocean. Two-thirds of the Chesapeake is rather river than bay, and two-thirds of the Potomac is rather bay than river. The narrowing and shoaling at the bay-mouth, imitated in the tributaries, explains the anomaly. Thus it happens that a range of 2.6 feet at the capes diminishes up the bay, but again increases to 4 feet at Richmond and 3 feet at Washington. The rate of progress of the tide-wave is here, as commonly, 10 to 12 miles per hour. When one tide is just above Washington another is entering the bay from the Atlantic, and high water reaches Havre de Grace, on the Susquehanna, as the following high water enters the mouth of the Rappahannock. The wave-front shows the usual steepening with advance. At Richmond the duration of rise is 4 h. 25 m.; at Fredericksburg, 4 h. 19 m.; at Washington, 5 h. 45 m. Port Deposit, on the Susquehanna, has the phenomenon of steeper back than front. A similar aspect is given at Galveston and perhaps at Falmouth by interference and a special development of the diurnal wave.



In every river an ascending wave must finally disappear. Of the Chesapeake rivers only the Elk shows this. The Pocomoke probably does; but we have no observations above Snow Hill,

and so far the ranges are still increasing. The larger rivers are interrupted by rapids at the fall line before the ranges diminish, usually close to the highest station observed.

ST LAWRENCE TIDES

The St Lawrence is an excellent example of a tidal estuary, and it is to be desired that more and more reliable data may some day be forthcoming for its study. For the present purpose we must exclude the portion of the so-called river between Pointe des Monts and Anticosti, where the tides are unexplained. The "bay" and river remaining are 283 miles long and 40 miles wide at the mouth. When high water has reached Three Rivers a second high water appears at the east end of Anticosti. The bay includes the waters between Pointe des Monts and Isle Royale, whence it is river to Three Rivers. The U. S. Tide Tables give 22 stations here, from which a table has been prepared as before.

St Lawrence Tides

0	I	II	III	IV	V	VI	VII	VIII	IX	H.W. interval from Pointe des Monts.
0	125	30	26	21	23	14	17	13	14	H. W. advance in last hour (miles).
9.2	12.9	13.3	14.4	13.9	13.3	11.0	8	3	2	Mean tide range (feet).
h. m.	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	
6 20	5 55	5 47	5 33	5 30	5 11	5 10	5 10	5 7	5 5	Duration of rise.
6 5	6 30	6 38	6 52	6 55	7 14	7 15	7 15	7 18	7 20	Duration of fall.

During the first four hours the tide travels up the bay with lessening speed, while the tide range steadily augments; then the advance is irregular and the range diminishes. At Three Rivers, the head of observations, the rise of tide lasts 5 h.; the fall, 7 h. 25 m.—not a strong steepening of the wave front after 283 miles of travel. This may be due to the great depth of the St Lawrence. The Penobscot is in these respects comparable.

The Bay of Chaleurs, a hundred miles long and twenty miles wide at the mouth, affords a good bay, the ranges mounting up from 4 feet to 7.6 feet and high water being delayed. There are but nine stations in the tide tables, which rather hint at the facts than elucidate them. It is clear that the tide-wave advances with its front looped deeply into the bay, as is probable with the St Lawrence and all deep bays.

ST JOHN RIVER TIDES

Our data here are all for mean springs of July and August, being due to a study by A. Willmer Duff.* In putting these data into the usual form, the time intervals have been taken from Indiantown. Although the tides are of a good river type, there is a unique feature in the tidal falls at the river's mouth. The entrance to the Bay of Fundy at the city of St John is by an estuary five miles wide in deep water. Spring-tide ranges at the city are of 27 feet; time of rise, 5 h. 40 m.; fall, 6 h. 45 m. Back of the city "the waters of the river, previously occupying a channel remarkable for its extent and breadth, become abruptly confined in a narrow gorge [which] has its immediate origin in a band of pre-Cambrian rock crossing the stream obliquely and forming a barrier, over which the waters of the river and of the bay flow alternately. From the relative levels of the harbor and river and the known rise of the tide, it would appear that the inward fall over the barrier at the suspension bridge is from nine to ten feet; but as this inward fall is wholly confined to the last third of the flood-tide, attaining its maximum with the latter and again rapidly receding, the interval during which the river is effectively resisted is greatly limited, not exceeding three or four hours out of every twelve. Notwithstanding the limitation, however, the effect is so far to set back the stream as to produce, except in time of freshet, an alternation of upward and downward currents, accompanied by a corresponding change of level, which is appreciable even at Fredericton, a distance of over 80 miles from the mouth, resulting at low water, in a rise and fall of not less than 10 inches."† Four times in the twenty-four hours there are ten-minute periods of level water,‡ and then steamboats can safely pass.§ At very high freshets in April and May there is no inward fall, as the tide does not rise high enough.‖

There has been some discussion as to the propriety of calling the oscillations that result in the St John river *tides*. Mr Duff's investigation, however, seems decisive. The oscillations are tidal in shape, period, and progression, and are visibly born of the Fundy tides in the Narrows; they are therefore tides. The distances in the table accompanying are from Indiantown, just upstream from the Narrows; the ranges in inches.

* Bulletin of Nat. Hist. of New Brunswick, vol. xv, 1897.
† L. W. Bailey, Roy. Soc. Can. Trans. 1882, p. 281.
‡ J. W. Bailey, St John River, p. 135.
§ Ward's Account of the River St John, p. 17.
‖ Lockwood's Nova Scotia, p. 97.

St John River Tides

0	I	II	III	IV	V	VI	VII	H. W. interval from Indiantown.
0	19	10	8	8	10	10	10	H. W. advance in last hour (miles).
26	15	11.5	10.3	9.7	8.6	7.7	6.2	Mean tide range (inches).
h. m. 5 40	*h. m.* 5 16	*h. m.* 5 16	*h. m.* 5 16	*h. m.* 5 17	*h. m.* 5 17	*h. m.* 5 18	*h. m.* 4 48	Duration of rise.
6 45	7 9	7 9	7 9	7 8	7 8	7 7	7 37	Duration of fall.

At Fredericton, over 70 nautical miles from Indiantown, the mean levels are 14 feet 4 inches above mean sea-level. The railroad levelings are used in this determination and may be open to some doubt; but Young asserts that tide runs 100 feet above sea in the Amazon,* and Airy† says the same thing happens in the Firth of Clyde, and, moreover, should happen from theory. As the wave progresses upstream 10 miles an hour, it is not to be supposed that the water poured inward from the Bay of Fundy travels upstream to cause the rise of water. The water is merely set oscillating. The Indiantown tides are themselves two hours later than the tides at St John, and the five-inch wave that reaches Springhill, 78 nautical miles upstream, spends over nine hours in the transit. Salt water is said to be detected 48 miles up the river, which is surprising.

PENOBSCOT TIDES

Penobscot bay has its outer waters so full of islands that the tidal bay must be counted to have its mouth from Camden to Castine. Thence to Bangor the ranges mount up steadily—9.7, 9.8, 10.2, 10.6, 12.0, 13.1 feet in 26 miles. The times indicate a clear retardation, though the series is short. Tide passes from Matinicus, the outer island, to Bangor in two hours. Above Bangor the river part is cut off by falls, and no river part is present. Only depth of water and freedom from sediment can allow such tides in a narrow channel.

KENNEBEC TIDES

The tide progresses from the sea to Augusta (45 miles) in four hours, with somewhat irregular speed and diminishing range.

* General Astronomy, p. 258.
† Encycl. Metropolitana, vol. iii, p. 338.

XUM

Kennebec Tides

0	I	II	III	IV	
0	11.5	8.5	16	8	H. W. interval from mouth.
0	11.5	8.5	16	8	H. W. advance in last hour (miles).
8.5	6.9	5.5	5.1	4.3	Mean tide range (feet).
h. m.	h. m.	h. m.	h. m.	h. m.	
6 23	5 57	5 53	5 36	5 1	Duration of rise.
6 2	6 28	6 32	6 49	7 24	Duration of fall.

Thames river, Connecticut, seems to have a small but typical bay tide. There are but two observation stations.

CONNECTICUT TIDES

The Connecticut has its mouth in the sand-bar region of the Middle bay, and itself discharges no small quantity of sediments, that make its exit to the sound an embarrassed one. Tide progresses up to Hartford (43 miles) in 4 hours and 48 minutes, with fairly constant speed, the ranges steadily diminishing.

Connecticut River Tides

0	I	II	III	IV	V	
0	9	9	11.5	7.5	9	H. W. interval from sound.
0	9	9	11.5	7.5	9	H. W. advance in last hour (miles).
3.6	2.7	2.0	1.4	1.0	0.6	Mean tide range (feet).
h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	
6 18	5 36	5 18	4 54	4 43	4 8	Duration of rise.
6 7	6 49	7 7	7 31	7 42	8 17	Duration of fall.

The stream is narrow, from a quarter to three-quarters of a mile, and shallow. The local geography affords a rational explanation for the lack of the "bay." The lower course of the river is cut in rocks so much harder than the upper course that the lower valley was gorge-like before drowning. The departure from the *ria* type is in the lack of uniformity of rock texture along the river.

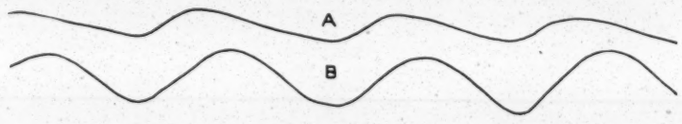
HUDSON TIDES

The Hudson also flows in a narrow gorge in its lower course and has no bay nor bay tide. Nearly as narrow as the Connecticut, but deep, it allows a more rapid transmission of the tide wave. The 141 miles to Albany are traveled in 10 hours and 8 minutes.

Hudson River Tides

0	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	
0	19	15	19½	21½	16½	11½	9½	10	9½	9½	8	H. W. interval from Sandy Hook.
0	19	15	19½	21½	16½	11½	9½	10	9½	9½	8	H. W. advance in last hour (miles).
4.6	4.2	3.6	3.3	3.3	3.3	3.4	3.2	3.0	2.9	2.4	.....	Mean tide range (feet).
h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	
6 7	5 49	5 49	5 44	5 47	5 43	5 27	5 19	4 57	4 52	4 42	.....	Duration of rise.
6 18	6 36	6 36	6 41	6 38	6 42	6 58	7 6	7 28	7 33	7 43	.....	Duration of fall.

The two curves below, which I owe to the courtesy of the Superintendent of the Coast Survey, show 48 hours of continuous observation at Albany and Sandy Hook. Both are on the same scale, and they well illustrate the extremes met in a river. The Albany tide, figure A, shows the characteristic steep front of waves that have traveled far in shallow water. The Hudson gets aid in its struggle with coastwise sands at Sandy Hook from the constant westward flow of water from Long Island sound through East river and out to sea.*



In closing this examination of estuary tides it appears that they vary from the type in our area only as their estuaries vary from the type of a river valley, narrow above and wide below, partly drowned in the sea. The commonest modification of this geographic type on the Atlantic coast results from the tendency of coastwise sands to close the bay mouths. This agency is evident at the mouths of the Hudson and Delaware; it gives the Chesapeake tides of a river type and encloses the mouths of the drowned valleys further south, forming the sounds in which lunar tides are less significant than the effects of prevailing winds.

* H. Mitchell: Ann. Rep. U. S. Coast Survey, 1886.

THE FOREST CONDITIONS AND STANDING TIMBER OF THE STATE OF WASHINGTON*

By HENRY GANNETT,

U. S. Geological Survey

During the past year I have been actively engaged in collecting information regarding the forest resources of this state, one of the richest in timber and the state in which the lumber industry is most active west of the Mississippi river. The information which has been collected consists of the reports of timber cruisers, showing the total amount of timber contained in the areas examined and its distribution among the five species recognized by the lumbermen of this part of the country—*i. e.*, red fir (*Pseudotsuga taxifolia*), Sitka spruce (*Picea sitchensis*), hemlock (*Tsuga mertensiana*), cedar (*Thuja plicata*), and yellow pine (*Pinus ponderosa*).

The figures, as they came to me, are by townships, showing the area cruised within each township and the amount of timber of each species. The figures are accompanied by maps, showing in considerable detail the areas which have been logged, burned, or are naturally devoid of timber, and those which are still timbered. Altogether I have in the state of Washington actual cruisings of 1,679,402 acres, or 2,600 square miles, which are pretty thoroughly scattered over the state. In addition to this are the examinations made of the Washington Reserve, an area of about 6,000 square miles, made during the past season. The cruisings, although scattered widely, are much more abundant and cover the area much more closely west of the Cascade range, in the most important timbered portion of the state, than east of those mountains.

The forests of Washington cover the Cascade range and the entire country west of it to the Pacific coast, with the exception of a few high summits of the Olympics and of the Cascades. They extend eastward along the northern part of the state to its east boundary, covering all the country southward as far as the Columbia river, and extend southward along the east bound-

*Presented at the Joint Session of the National Geographic Society and the A. A. A. S., Boston, August 25, 1898.

ary in a narrow fringe to its southeast corner, where the forests of the Blue mountains cover a considerable area. Altogether I estimate that out of the total area of the state 47,700 square miles, or 71 per cent, are wooded. All this is not, however, covered with merchantable timber, inasmuch as much of it is inferior in character, and other large areas have been cut or burned and are now growing up again.

From the data collected I estimate the total amount of standing timber in the state to be in the neighborhood of 187,000,000,000 feet, of which amount more than two-thirds, or 137,000,000,000 feet, are found west of the crest of the Cascade range, the remainder, 60,000,000,000, being upon its east slope and in the northern and eastern portions of the state. This is the amount as estimated upon the basis of the practice of the lumbermen of the west coast, where the standard for lumber is extremely high and the practice in cutting very wasteful. For instance, in this region no tree is cut unless it will furnish at least two sticks each 20 feet in length, and each of which will square 15 inches, or have a diameter on the trunk of at least 2 feet, nor is anything used which is at all knotty, only clear lumber being cut. The remainder of the tree, after selecting the parts above described, is left to rot or to add to the conflagrations which sweep through the region every summer.

The forests west of the higher parts of the Cascade range are composed of 62 per cent of red fir, 16 per cent of cedar, 14 per cent of hemlock, and 8 per cent of spruce. The fir is found most abundantly in the depression between the Cascade and Coast ranges, where the forest is almost entirely composed of it. Its range extends up the mountains to an altitude of about 3,000 feet, where its place is taken by hemlock and cedar. Toward the Pacific coast the proportion of fir diminishes and its place is taken by spruce, which is most abundant immediately on the coast, and by cedar. Hemlock is found mainly upon the mountain slopes, which it climbs to a much greater altitude than fir.

Yellow pine is found only east of the crest of the Cascades, but throughout this region it is the predominant growth. At considerable altitudes its place is taken, to a large extent, by lodge-pole pine (*Pinus murrayana*), which throughout this region is regarded as of no possible use, although farther east, where timber is scarce, it is considered to be of value.

The portion of Washington west of the crest of the Cascades, concerning which I have the fullest data, is one in which lum-

bering has been carried on very extensively for nearly a generation, and the results of these extensive operations, coupled with the terrible fires which devastate the region, are of much interest. From the maps which have been obtained I find that of the accessible part of this region—*i. e.*, those parts which are regarded by the present lumber practice as containing available timber—not less than 45 per cent have been cleared, either by cutting or fire, within recent times. About 23 per cent of this entire area has been logged; about 22 per cent has been burned. Presumably the amount of timber cut and burned and its value are at least proportional to the areas, and therefore it would follow that not very much less than one-half of the available lumber in this part of Washington has been destroyed since its occupation by whites. We cannot complain of the cutting, providing it is done with some sort of economy, but no condemnation can be too severe for the carelessness which allows such an enormous amount of wealth to be destroyed by fires.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Fiftieth Anniversary Meeting of the American Association for the Advancement of Science was held in Boston, August 22 to 27. As was anticipated, the return of the Association to the city of its birth for the celebration of its semi-centennial was the occasion of an unusually large attendance, it excited more than ordinary local interest, and resulted in a very large accession to the membership.

Of the 330 or more papers presented, many contained important contributions to the different sciences. Those of especial geographic interest were for the most part read in Section E, which held a joint session with the National Geographic Society on August 25. On that occasion Dr Marcus Baker, cartographer to the Venezuela Boundary Commission, discussed the Venezuela-British-Guiana Boundary Dispute; Prof. W J McGee, Vice-President of the National Geographic Society, traced the Geographic Development of the United States; Mr Mark S. W. Jefferson explained the peculiar characteristics of Atlantic Estuarine Tides, and the Statistician of the Department of Agriculture set forth the Considerations that have governed recent Movements of Population. The following papers were also presented: "Some

New Lines of Work in Government Forestry," by Mr Gifford Pinchot; "The Forestry Conditions of the State of Washington," by Mr Henry Gannett; "The Bitter Root Forest Reserve," by Mr Richard U. Goode, and "The Five Civilized Tribes and the Topographic Survey of Indian Territory," by Mr Charles H. Fitch. Of these various addresses and papers four are published in the present number of this journal.

Among the papers read at other times or before other sections and of interest to geographers may be mentioned the following: Before the Section of Geology and Geography, "Geography and Resources of the Siberian Island of Sakhalin," by Prof. Benj. Howard, of London; "The Development of the Ohio River," by Prof. W. G. Light, and "The Continental Divide in Nicaragua," by Mr C. Willard Hayes; before the Section of Anthropology, "The Maori of New Zealand; His History and Country," by Hon. Hugh H. Lusk, of London; "Origin of the Confederacy of the Five Nations," by Mr Ch. H. Henning; "The Disappearance of the Cliff Dwellers," by M. Desire Charnay, of Paris; "The Smith Sound Eskimo," by Mr A. L. Kroeber; "The Philippine Islands and their People" and "Moros, or Malay Pirates of the Southern Philippines," by Prof. Dean C. Worcester; and before the Section of Economic Science and Statistics, "Cuba: Past, Present, and Future" and "Nicaragua and the Canal," by Dr Wolfred Nelson; "The Development of Colonial Policy," by Prof. John Davidson; "The Progress of the Maritime Commerce of the World during the past Fifty Years," by Dr E. L. Corthell, C. E., and "Cuba," by Prof. Robert T. Hill.

It is much to be regretted that at several sessions the large number of papers to be presented precluded all possibility of discussion, and it may be doubted whether it would not contribute to the usefulness of future meetings if some limitation were imposed by the Committee upon the number and length of the papers to be submitted.

Not even this brief narrative of the proceedings of the Association in one single direction should be permitted to go without reference to the admirable arrangements made by the Local Committee, to the generous hospitality of the citizens of Boston, Cambridge, Salem, Lexington, and other places, and to the extreme gratification it afforded the Association to have occupying the presidential chair its indefatigable secretary for 25 years, Dr Frederic Ward Putnam, the distinguished Peabody Professor of American Archæology and Ethnology in Harvard University.

J. H.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1897–'98

Special Meeting, April 29, 1898.—Mr W J McGee in the chair. Professor J. L. Ewell, of Howard University, gave an illustrated lecture on Old Germany before the Reformation.

Special Meeting, May 2, 1898.—Mr W J. McGee in the chair. Professor Josiah Royce gave an illustrated lecture on The Pacific Coast, particularly describing the influence of geographic environment on the early inhabitants.

Regular Meeting, May 6, 1898.—Mr G. K. Gilbert in the chair. Mr N. H. Darton gave an illustrated address on the geologic and geographic environment of Harpers Ferry, and Major H. E. Alvord, C. E., described the principal events which occurred there during the civil war.

Special Meeting, May 9, 1898.—Mr W J McGee in the chair. Mr William E. Curtis gave a description of Porto Rico, and Col. F. F. Hilder spoke on the Philippine Islands, both addresses being illustrated with maps and views.

Annual Excursion and Field Meeting, May 14, 1898.—An excursion, postponed from May 7 on account of unfavorable weather, was made to Harpers Ferry, leaving Washington by special train at 8.50 a. m. The day's proceedings included a field meeting, at which addresses were delivered by Mr W J McGee and Col. H. C. Rizer, and the visiting of the different points of geographic and historic interest for which the district is famous.

Annual Meeting, May 20, 1898.—Vice-President A. W. Greely in the chair. The report of the Recording Secretary was read and approved. The report of the Treasurer was presented, and referred to an auditing committee, consisting of Prof. Willis L. Moore, Mr Weston Flint, and Col. H. C. Rizer, after it should be brought down to the end of the fiscal year expiring May 31.

Dr Alexander Graham Bell, Mr Henry Gannett, Gen. A. W. Greely, U. S. A., Mr John Hyde, Prof. W J McGee, and Mr F. H. Newell were reëlected members of the Board of Managers.

The amendments to the By-Laws, presented in writing at the meeting on April 22, were taken up and read section by section. After debate and a slight amendment to article 6, section 4, they were adopted by a two-thirds vote of the members present, the By-Laws, as approved, being as follows:

ARTICLE I.—*Name.*

The name of this Society is 'THE NATIONAL GEOGRAPHIC SOCIETY.'

ARTICLE II.—*Object.*

The object of this Society is the increase and diffusion of geographic knowledge.

ARTICLE III.—*Membership.*

SECTION 1. The members of this Society shall be persons interested in

geographic science. There may be three classes of members—active, corresponding, and honorary.

SECTION 2. Active members only shall be members of the corporation and may vote and hold office.

SECTION 3. Persons residing at a distance from the District of Columbia may become corresponding members.

SECTION 4. Persons who have attained eminence by the promotion of geographic science may be elected honorary members.

SECTION 5. The election of members shall be entrusted to the Board of Managers.

SECTION 6. Corresponding members may be transferred to active membership, and active members to corresponding membership, by the Board of Managers.

ARTICLE IV.—*Officers.*

SECTION 1. The administration of the Society shall be entrusted to a Board of Managers composed of eighteen members, six of whom shall be elected by the Society at each annual meeting to serve for three years, or until their successors are elected. A majority of the votes cast shall be necessary for election.

SECTION 2. The Board of Managers shall elect annually from their own number a President, a Vice-President, a Treasurer, a Recording Secretary, and a Corresponding Secretary.

SECTION 3. The President shall preside at the meetings of the Society and of the Board of Managers, or shall delegate this duty to the Vice-President or other member of the Board. The President and Recording Secretary shall sign all written contracts and obligations of the Society.

SECTION 4. In the absence of the President his duties shall devolve on the Vice-President.

SECTION 5. The Treasurer shall have charge of the funds of the Society, under the direction of the Board of Managers, and shall make collections and disbursements, and render an annual report; and his accounts shall be audited by a committee of the Society, not members of the Board, annually and at such other times as the Board may direct.

SECTION 6. The Recording Secretary shall record the proceedings of the Society and of the Board of Managers, and make an annual report. The Corresponding Secretary shall conduct correspondence on behalf of the Society.

SECTION 7. The Board of Managers shall fill vacancies arising in the Board.

SECTION 8. Absence of a member of the Board of Managers from five successive Board meetings may, in the discretion of the Board, be considered equivalent to resignation.

ARTICLE V.—*Committees.*

SECTION 1. The committees of the Society and of the Board of Managers shall be appointed by the President, except when otherwise provided by resolution. The President shall be a member *ex officio* of every committee

SECTION 2. There shall be Standing Committees on Publication, Communications, Admissions, Research, and Finance, whose chairmen shall

be members of the Board of Managers. These committees shall be appointed at the beginning of each fiscal year to serve until their successors are designated.

ARTICLE VI.—*Dues.*

SECTION 1. The annual dues of active members shall be five dollars, of corresponding members two dollars.

SECTION 2. The fiscal year of the Society shall begin on the first day of June. The annual dues of new members shall be payable within thirty days after election. The dues of members elected in April or May shall be credited to the following year.

SECTION 3. Annual dues may be commuted and life membership acquired by the payment at one time of fifty dollars.

SECTION 4. Members in arrears shall not be entitled to vote at the annual meeting, and members two years in arrears shall be dropped from the roll.

ARTICLE VII.—*Meetings.*

SECTION 1. Regular meetings of the Society shall be held on alternate Fridays from November until May.

SECTION 2. Special meetings may be called by the President.

SECTION 3. The annual meeting shall be the last regular meeting in May.

SECTION. 4. Twenty-five active members shall constitute a quorum.

SECTION 5. Regular meetings of the Board of Managers shall be held on the same days as the regular meetings of the Society; special meetings may be held at the call of the President or on notice signed by five members of the Board.

ARTICLE VIII.—*Publications.*

The Society shall publish a journal or periodical under the title, THE NATIONAL GEOGRAPHIC MAGAZINE, which shall be sent to all members of the Society not in arrears, and may be placed on sale.

ARTICLE IX.—*Amendments.*

These By-Laws may be amended by a two-thirds vote of the members present at any regular meeting, provided the proposed amendments are reported by the Board of Managers, and provided that printed notice thereof has been sent to all active members of the Society not less than three nor more than thirty days before the meeting.

ELECTION OF OFFICERS.—At a meeting of the Board of Managers, held June 3, officers for the ensuing year were elected as follows: President, Dr Alexander Graham Bell; Vice-President, Prof. W J McGee, Treasurer, Mr Henry Gannett; Recording Secretary, Mr F. H. Newell; Corresponding Secretary, Miss Eliza Ruhamah Scidmore.

ELECTIONS.—New members have been elected as follows:

May 6.—H. E. Orsborn, S. W. McCallie.

June 3.—Mrs C. Atwater Day, Hon. Lewis E. Payson, W. W. Burdette, Rev. Charles D. Kreider.

June 24.—J. B. Bottineau, H. Hayden Sands, S. J. Caswell, M. D.

July 18.—Walter E. Colwell, Eugene La Grove, Dr J. C. Gordon, G. Shelby Crump.

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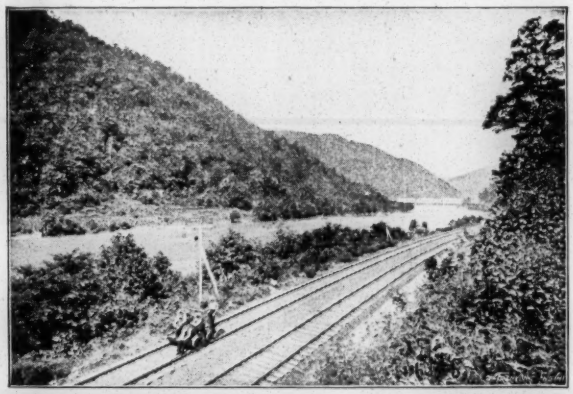

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Volume XI Begins with January, 1898.

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COMMENCED JANUARY, 1888. TWO VOLUMES PER YEAR.

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